

The logo for 'must' features the word in a bold, blue, lowercase sans-serif font. To its left, a yellow graphic consists of several thin lines intersecting at a central point, resembling a stylized star or a molecular structure.

must

Molecular Ultrafast
Science and Technology

National Center of Competence in Research

NCCR MUST

An den Grenzen des Messbaren:
Die schnellsten Vorgänge der Natur

Thomas Feurer, Co-Direktor, Universität Bern

Ursula Keller, Direktor, ETHZ

James Seymore (1702 – 1752)



Ich meine gesehen zu haben,
dass sich alle vier Hufe in der
Luft befanden.

Ich bitte Sie, Pferde fallen
doch um, sollten alle vier
Hufe in der Luft sein !

Ein
zw
ein



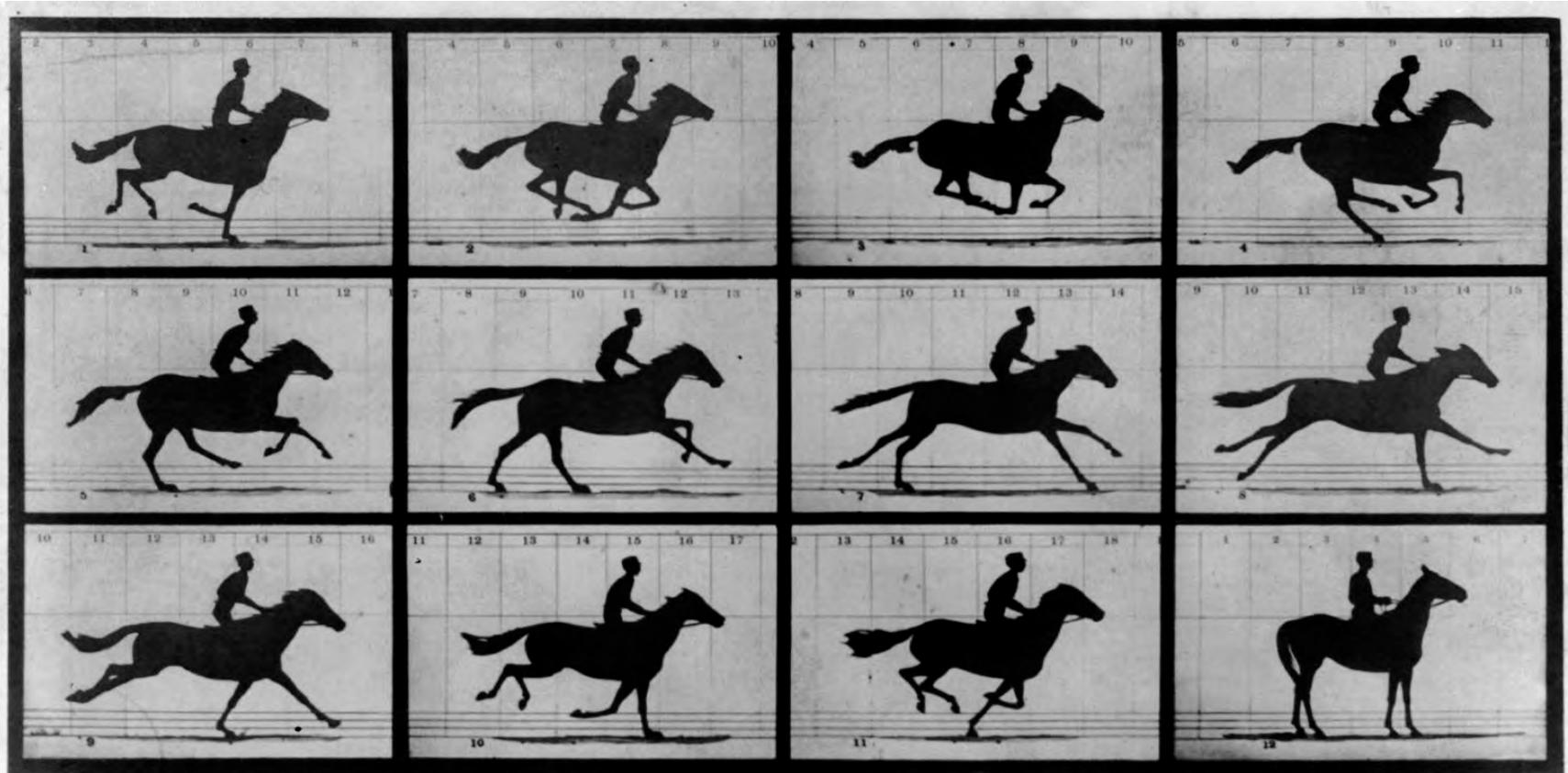
ine
o
f in



Stroboskop
Beleuchtung



Viel zu langsam !



Copyright, 1878, by MUYBRIDGE.

MORSE'S Gallery, 417 Montgomery St., San Francisco.

THE HORSE IN MOTION.

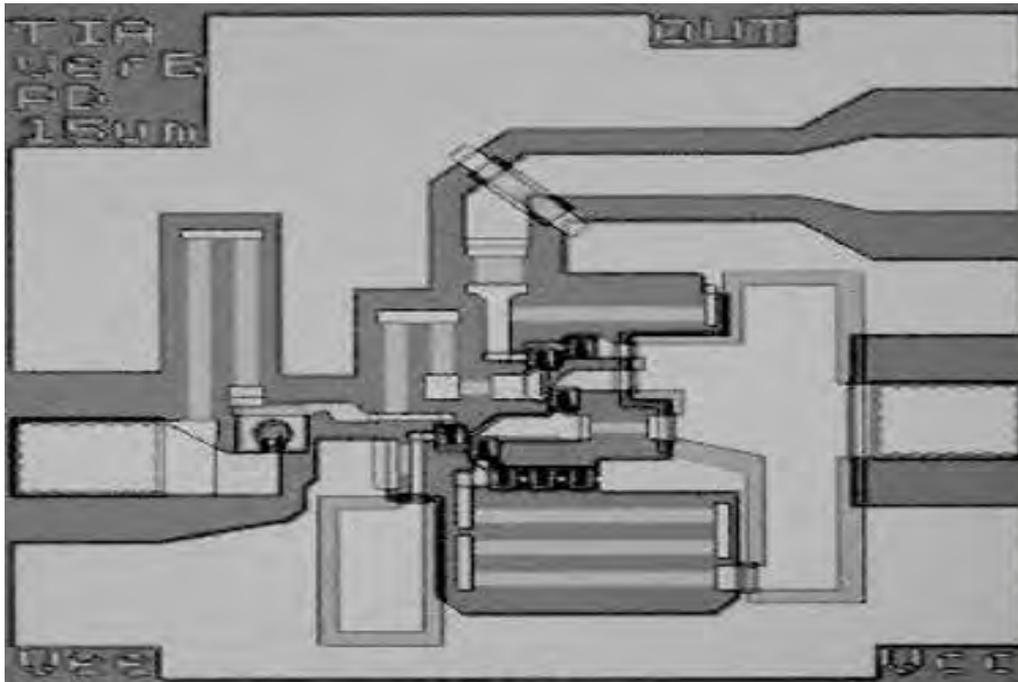
Illustrated by
MUYBRIDGE.

AUTOMATIC ELECTRO-PHOTOGRAPH

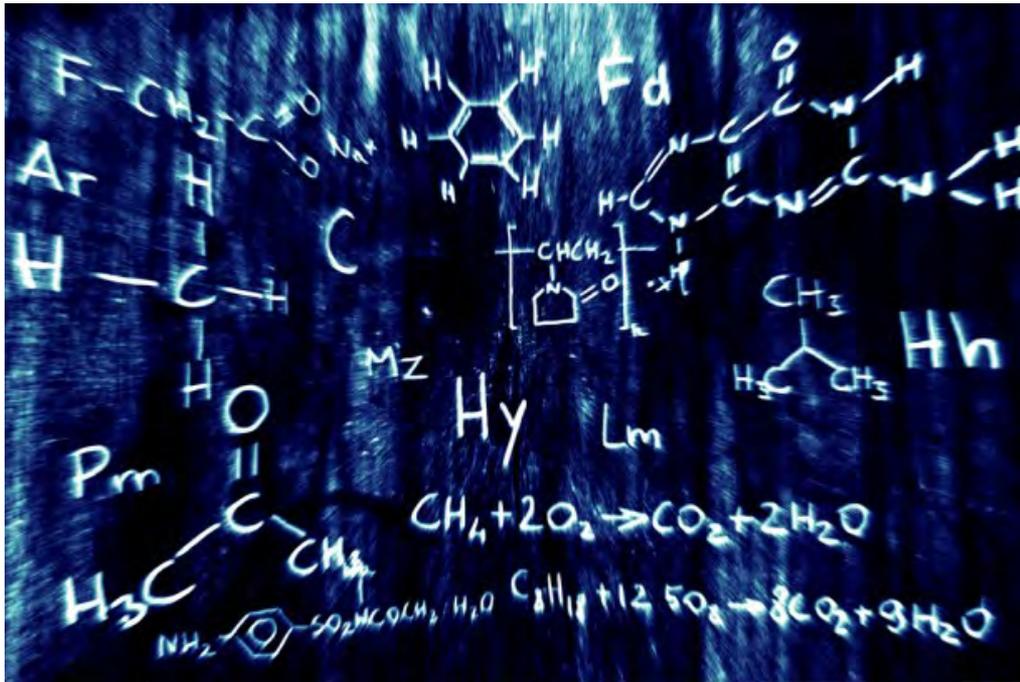
"SALLIE GARDNER," owned by LELAND STANFORD; running at a 1.40 gait over the Palo Alto track, 19th June, 1878.

The negatives of these photographs were made at intervals of twenty-seven inches of distance, and about the twenty-fifth part of a second of time; they illustrate consecutive positions assumed in each twenty-seven inches of progress during a single stride of the mare. The vertical lines were twenty-seven inches apart; the horizontal lines represent elevations of four inches each. The exposure of each negative was less than the two-thousandth part of a second.

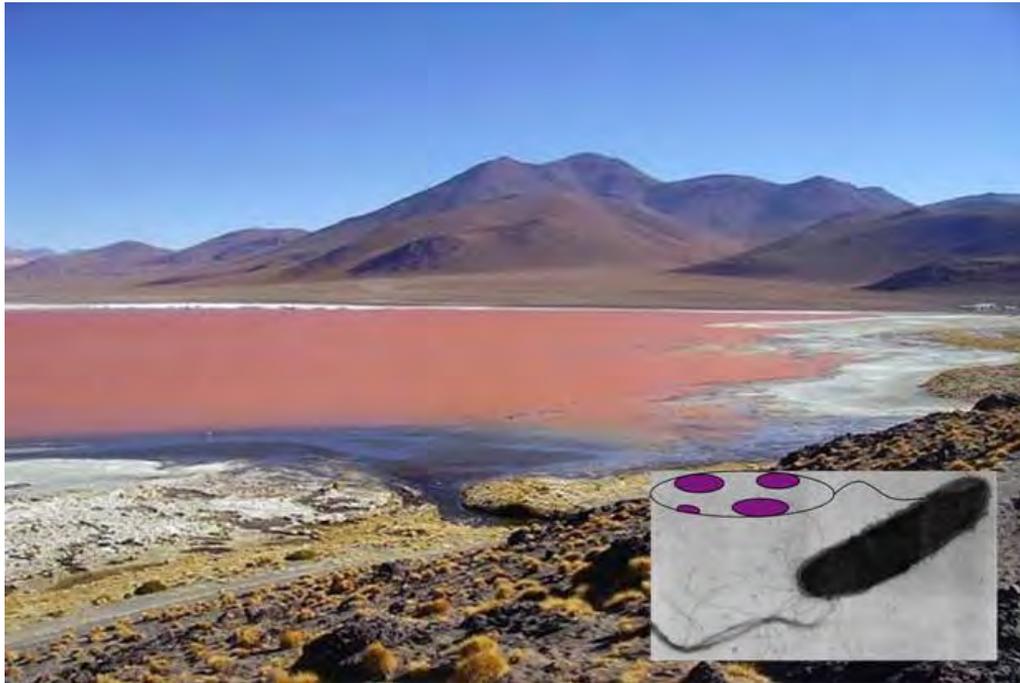
- Hochgeschwindigkeitselektronik und -datenverarbeitung



- Chemische und Biochemische Prozesse

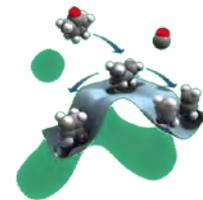


- Photosynthese



Wie schnell ist ultraschnell ?

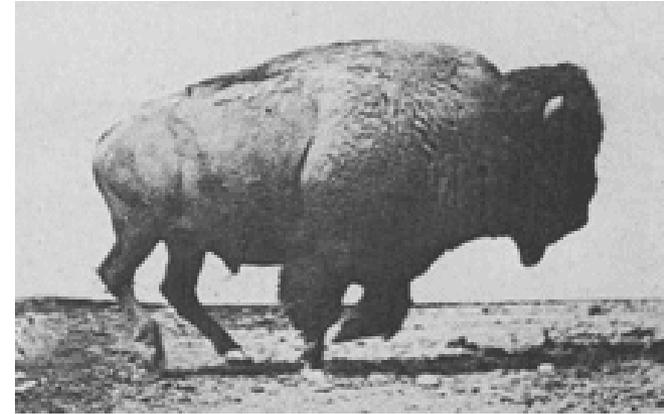
1s 1ms 1us 1ns 1ps 1fs 1as



1 Pikosekunde (1 ps)
1 Femtosekunde (1 fs)
1 Attosekunde (1 as)

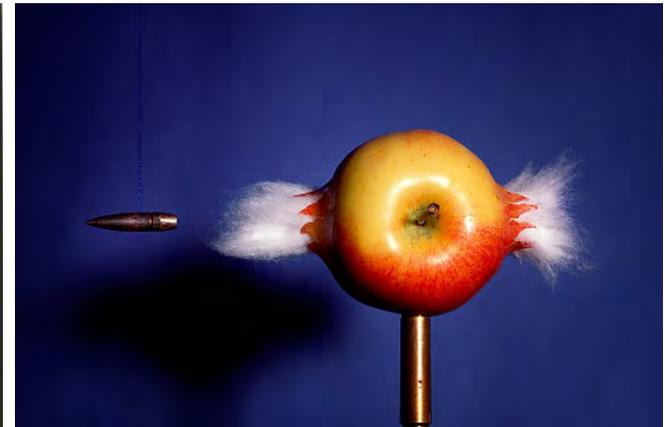
0.000'000'000'001 s
0.000'000'000'000'001 s
0.000'000'000'000'000'001 s

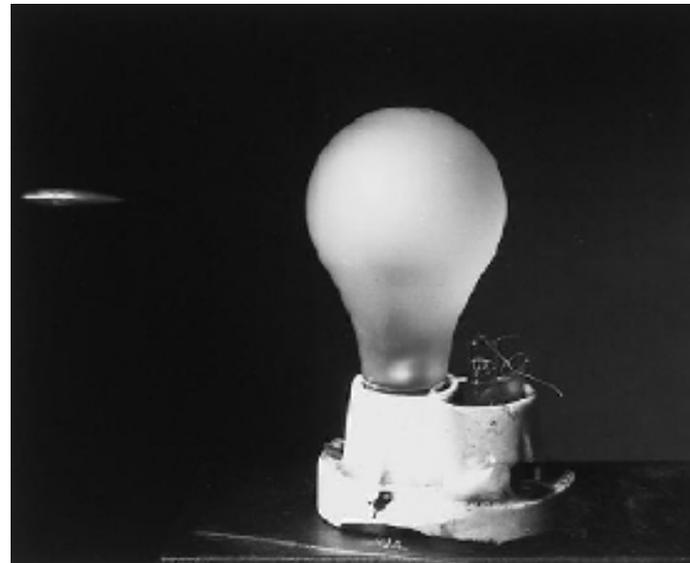
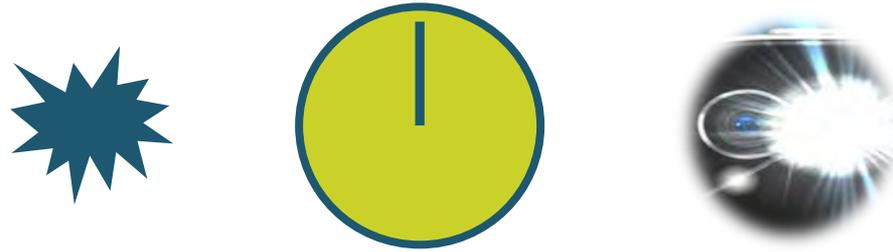
Millisekunden 0.001 s
Eadweard Muybridge (1830 bis 1904)



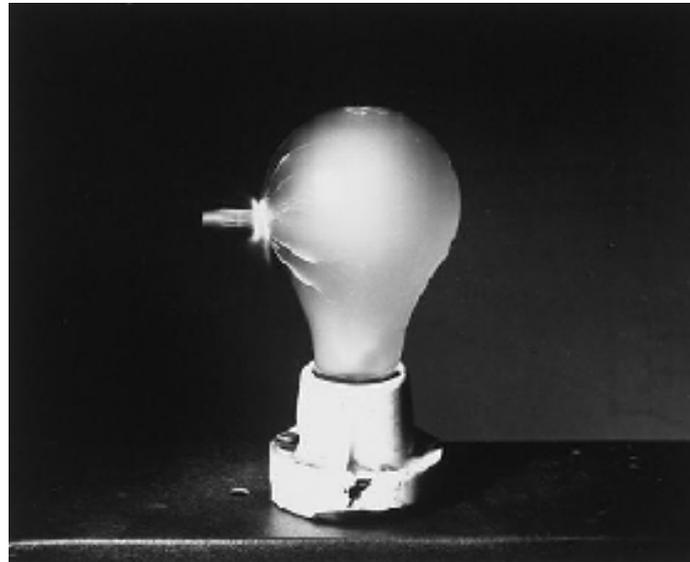
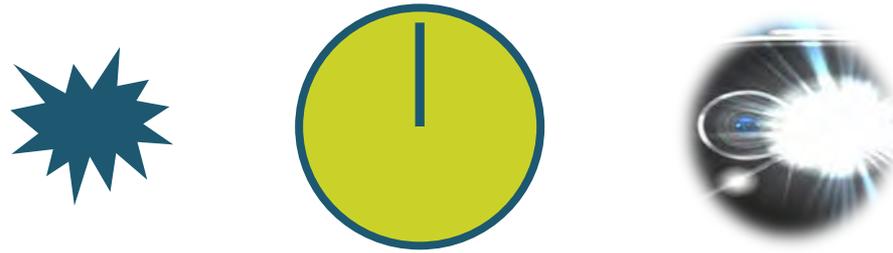
Mikrosekunden 0.000'001 s

Harold E. Edgerton (1903 bis 1990)

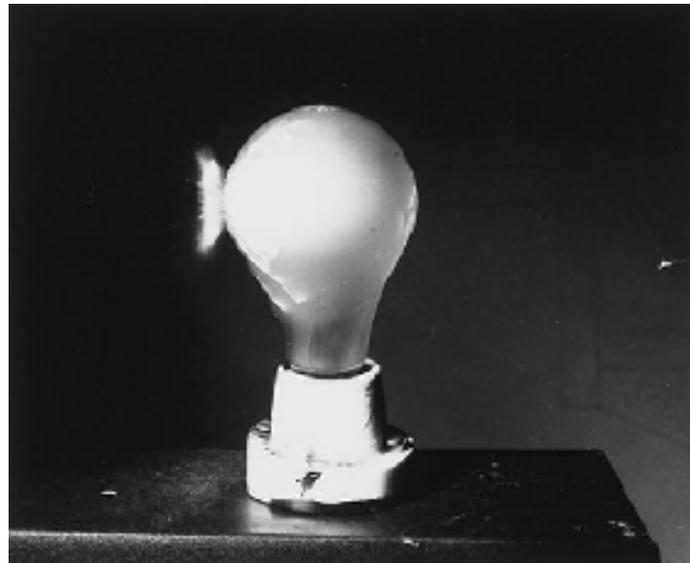
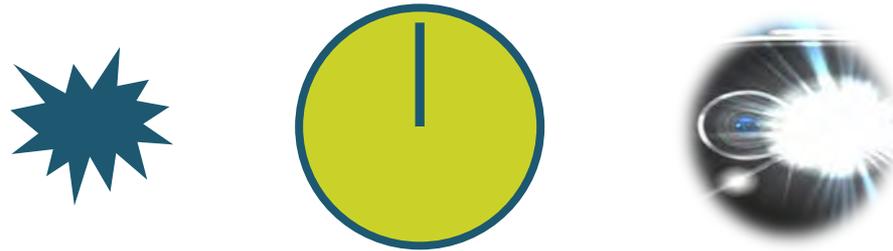




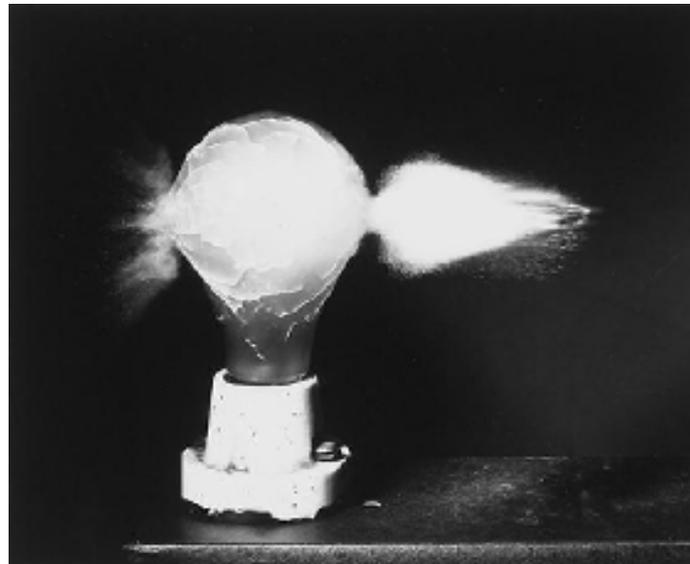
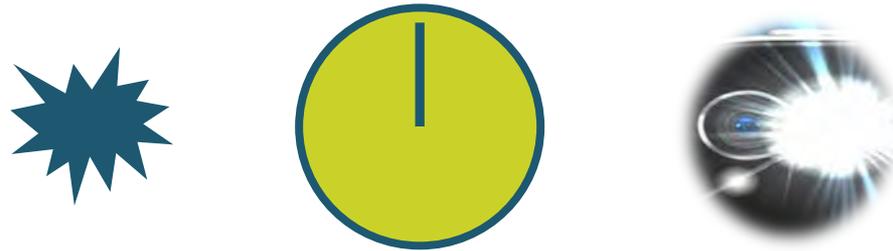
Harold E. Edgerton (1903 bis 1990)



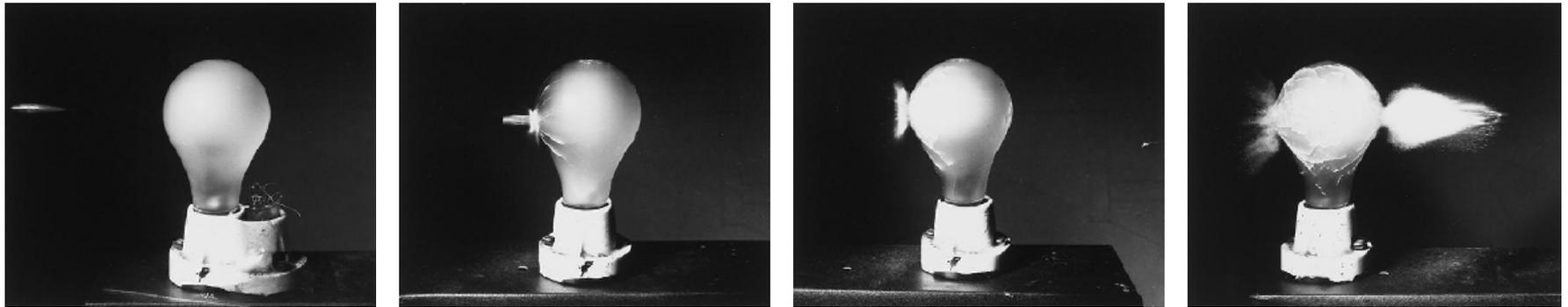
Harold E. Edgerton (1903 bis 1990)



Harold E. Edgerton (1903 bis 1990)



Harold E. Edgerton (1903 bis 1990)



Zeit

Δt_1

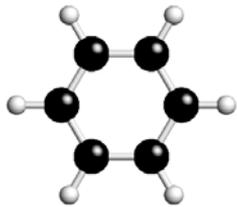
Δt_2

Δt_3

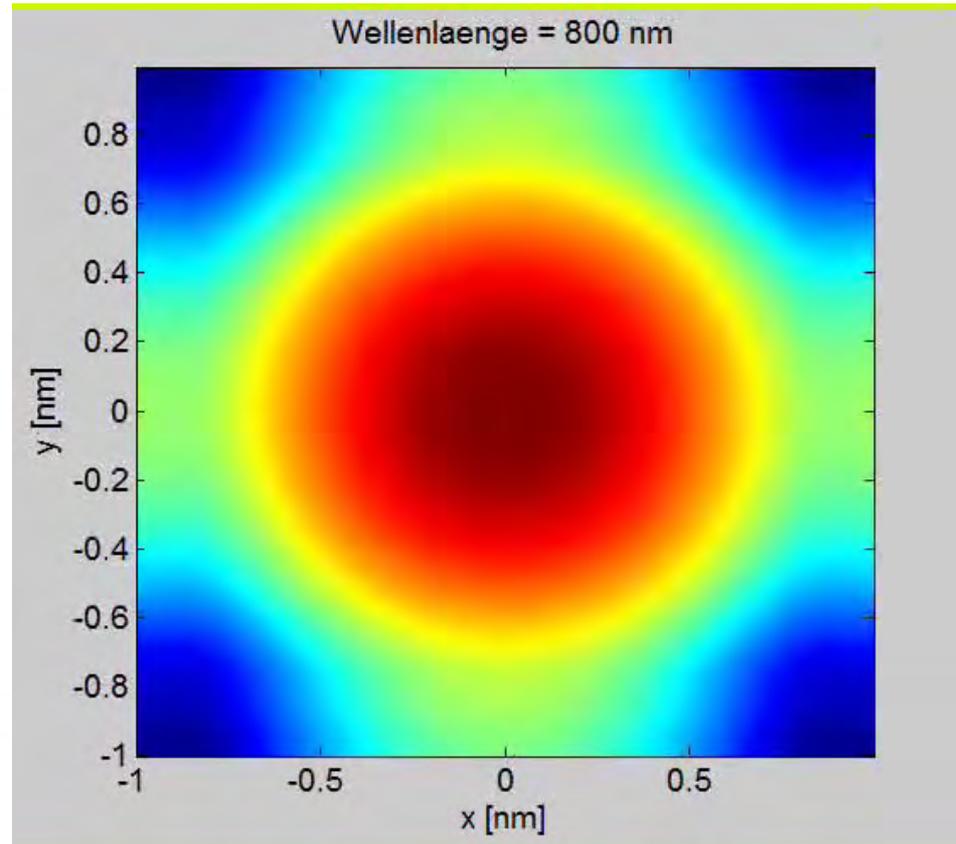
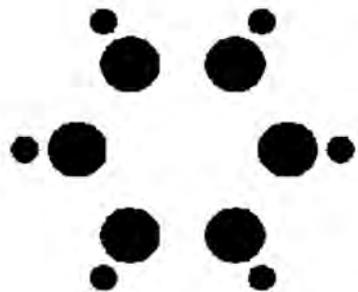
Δt_4

Harold E. Edgerton (1903 bis 1990)

Und wie macht man einzelne Atome sichtbar ?

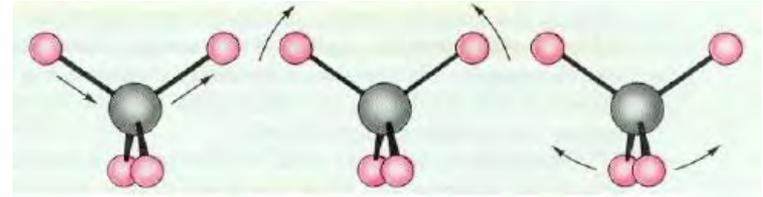


Benzol



Atome sind sehr klein und bewegen sich extrem schnell

Typische Länge 0.000'000'000'1 m
Typische Zeit 0.000'000'000000'001 s

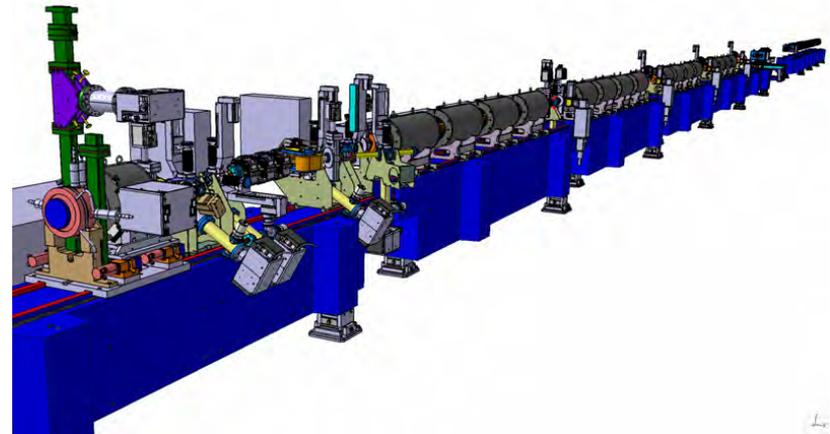


Wie lösen wir dieses Problem ?

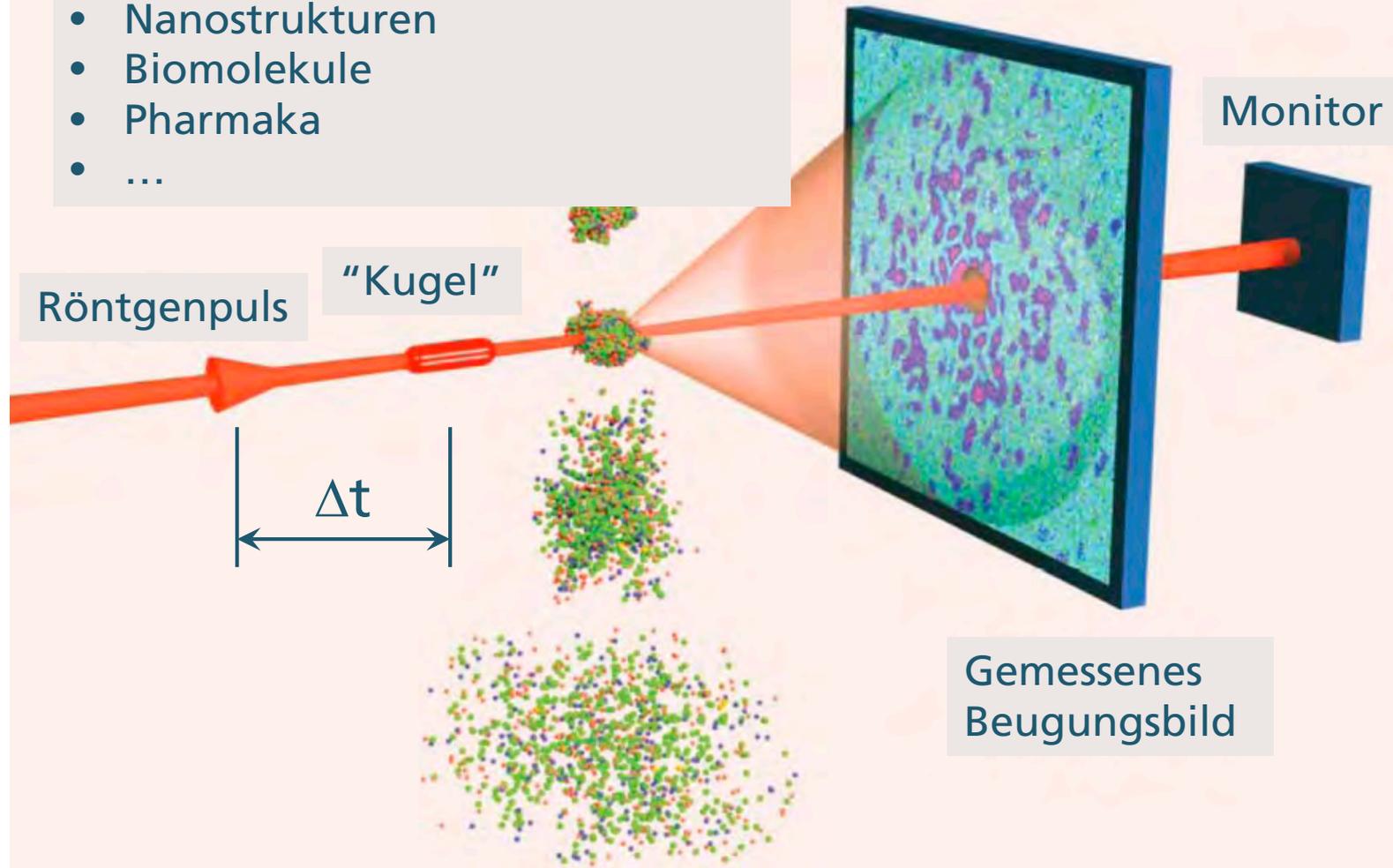
... mit ultraschnellen Röntgenlaserblitzen



SwissFEL



- Chemische Reaktionen
- Magnetische Eigenschaften
- Nanostrukturen
- Biomolekule
- Pharmaka
- ...



- Physik (1901)
- Physik (1914)
- Physik (1915)

- Physik (1917)
- Physik (1924)
- Physik (1927)
- Chemie (1936)
- Physiologie/Medizin (1956)

- Chemie (1962)
- Physiologie/ Medizin (1962)
- Chemie (1964)
- Chemie (1976)
- Physiologie/Medizin (1979)
- Chemie (1985)
- Chemie (1988)
- Chemie (2012)

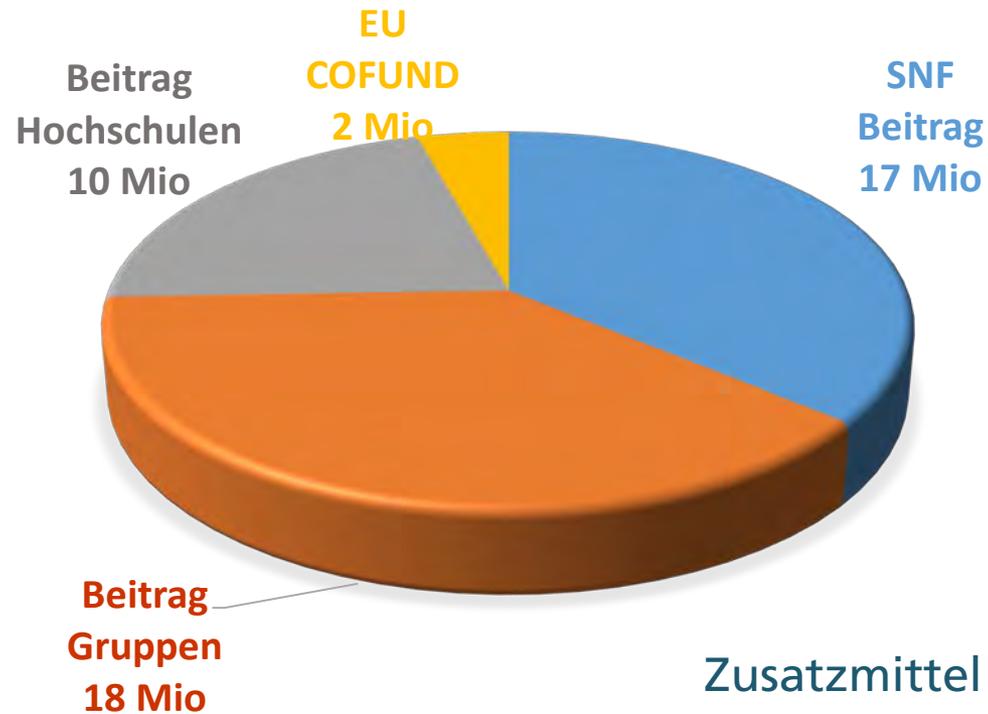
Wilhelm Conrad Röntgen
Max Felix Theodor von Laue
William Henry Bragg,
William Lawrence Bragg
Charles Glover Barkla
Karl Manne Georg Siegbahn
Arthur Holly Compton
Peter Joseph Wilhelm Debye
André Frédéric Cournand
Werner Theodor Otto Forßmann
Dickinson Woodruff Richards
John Cowdery Kendrew, Max Ferdinand Perutz
Francis H.C. Crick, Maurice H.F. Wilkins, James D. Watson
Dorothy Mary Hodgkin, geb. Crowfoot
William Nunn Lipscomb
Allan MacLeod Cormack, Godfrey Newbold Hounsfield
Herbert Aaron Hauptmann, Jerome Karle
Johann Deisenhofer, Robert Huber, Hartmut Michel
Robert J. Lefkowitz, Brian K. Kobilka



18 Forschergruppen
8 Juniorgruppen
9 Assoziierte Forschergruppen



Jahresversammlung 2013
150 Teilnehmer



Zusatzmittel durch Exzellenz

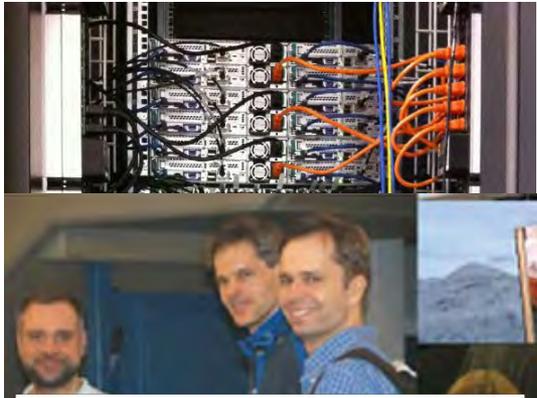
- 3 ERC "Advanced Grants"
- 4 ERC "Starting Grants"
- 5 SNF "Assistenz Professoren"

Ein NCCR ist mehr als die Summe seiner Teile

- Grossprojekte (zu gross für einzelne Gruppen)
- Interdisziplinäre Forschungsprojekte
- NCCR weite Infrastrukturmassnahmen
- Langfristige Forschungsplanung (12 Jahre)

- Nachwuchsförderung

- Frauenförderung



Retaining Talented Women Scientists: Time to Try Harder

Ursula Keller

VIEWPOINT

When I began my career 30 years ago, I was convinced that all I had to do in order to become a successful scientist was to be very good at my job and to excel in my scientific expertise. I believed that there was no longer discrimination against women in science, and I was positive that I wanted to build a career and, if I chose to, have a family. None as a tenured female professor with a spouse and children. I look back on my career and find that the time of women in science is much more complicated than I had initially thought.

Don't get me wrong. I have an exciting, exhilarating and fulfilling job. Yet I still find myself lamenting as I re-examine the experience as wholly positive. While I've engaged in many wonderful research collaborations with my colleagues, I have also experienced a number of incidents that have led me to conclude that there is something systemic going on in science. Women and some men are experiencing discouraging behavior and attitudes that provide disincentives for them to remain in academic science.

In my early career at Stanford University and Bell Laboratories, one of the most motivating pieces of advice I received from a scientific colleague and mentor was: "No one said it would be easy, just try harder." That powerful statement became a mantra for me. I kept it in mind as I built up a large research group, raised two children, and established a scientific track record. I have now been a tenured professor for 17 years, and I currently serve as the director of a multi-collaborative Swiss National Science Foundation project. I became a successful science professor. However, my advice was right. It has not been hard.

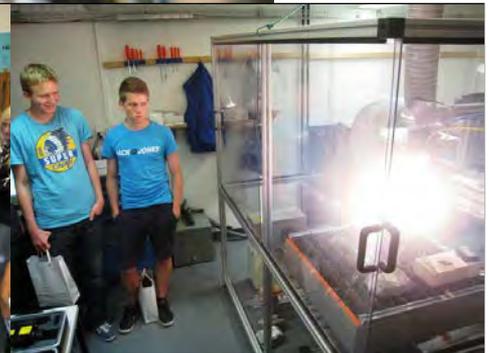
My experience as a woman scientist has been much more complicated than the scientific reputation I have established. I have had to deal with challenging issues and attitudes related to starting a family, organizing my laboratory space, and building up my research group. To gain a wider perspective on my experience, I turned to numerous research reports on the absence of women in science, and the evidence is there, cited again and again. Within the scientific culture, women face discriminatory attitudes that often lead them to be excluded, along with minorities. An article about subtle discrimination published in the *Washington Post* by physics professor Meg Urry highlighted experiences that were analogous to mine (see link in the references).

There are many special programs geared toward encouraging women scientists to remain in academia. They advise women on how to fit better within the academic environment. You will succeed if you are excellent in your work, if you find a mentor, if you choose a supportive life partner, if you improve your confidence, and if you make sure that you speak out so that you do not seem invisible. These tips are surely helpful, but why is the responsibility for change always put on these talented people? My experience shows that this is too simple a solution. The scientific community must make greater efforts within individual disciplines to identify and change the factors prohibiting women and others from staying in science.

The 2009 gender statistics for the physics department at ETH Zurich in Switzerland show the representation of women as follows: 16.5 percent of undergraduates are women; 17.7 percent of Ph.D. students are women; and 13.3 percent of post-docs are female. I am, one of two tenured women professors; overall, women comprise 15 percent of the faculty.

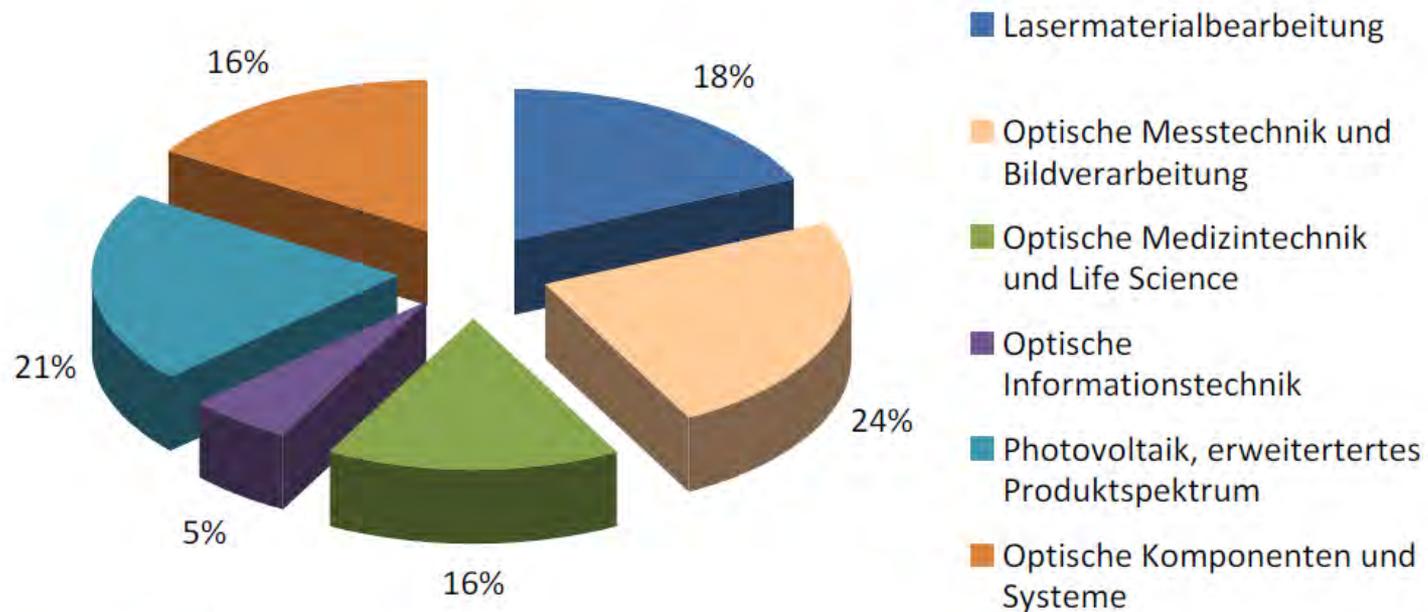
I feel very positively about my life choices, but I am aware that retaining

Uni Bern – Photonics Days



Photonik-Industrie - Mitarbeiter am Standort Schweiz, 2011

Total: 10 200 MitarbeiterInnen



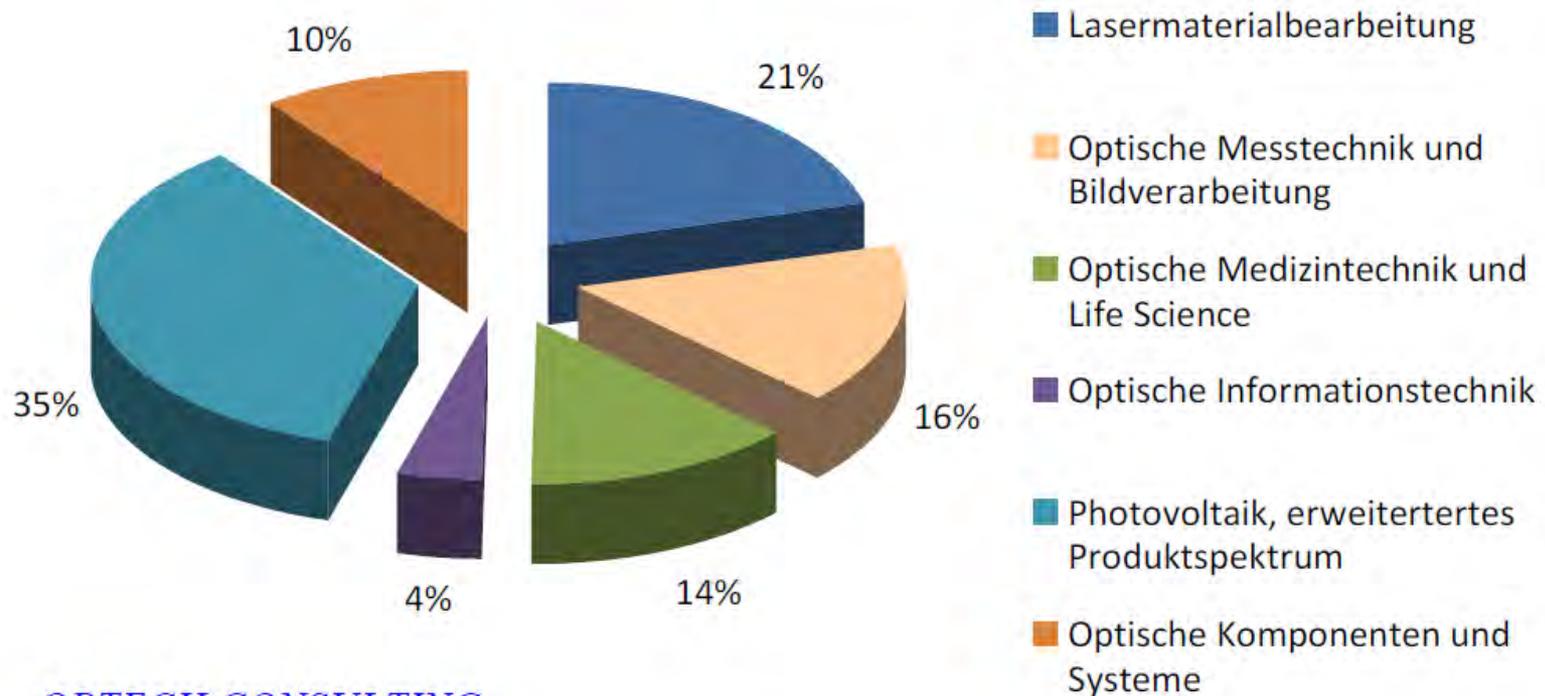
OPTECH CONSULTING



- Workshops zum Beispiel über Instrumentierung (mit SwissPhotonics)
- Industrie Projekt Program (IPP): Seed funding für gemeinsame Projekte
- Spin-offs (Ionight, Uni Bern) AXA Innovation award 2013
- Software Entwicklungen
- Joint Laser Research Institute (APRI, Süd Korea und IAP, Uni Bern)

Photonik - Umsatz Unternehmen Standort Schweiz, 2011

Total: 4.1 Milliarden CHF



OPTECH CONSULTING

- Entwicklung neuer optischer Schneidköpfe
- Nächste Generation Laser (CO₂ Laser -> Faserlaser)
- Virtuelle Metallschneidemaschine

Hersteller (alphabetisch)	Wichtige Photonik-Produkte am Standort Schweiz
Bystronic (Conzzeta)	Laser-Flachbettschneidanlagen, Hochleistungs-CO ₂ -Laser
Lasag (Rofin Sinar)	Festkörperlaser zum Feinschneiden und Feinschweissen
Leister	Laser-Kunststoffschweissysteme
Oclaro	Hochleistungslaserdioden
Soudronic	Laserschweissysteme für Bleche
Synova	Schneidanlagen auf Basis Laser-Micro-Jet
Oerlikon Solar (Tokyo Electron)	Laser-Strukturierungsanlagen für Solarzellen
Trumpf	Laser-Flachbettschneidanlagen, Laser-Beschrifter

